

Learning About Mosses in Our Northeastern Woodlots: An Introduction

Northeastern Area State and Private Forestry
Forest Service, U.S. Department of Agriculture
Newtown Square, PA
www.na.fs.fed.us
June 2010

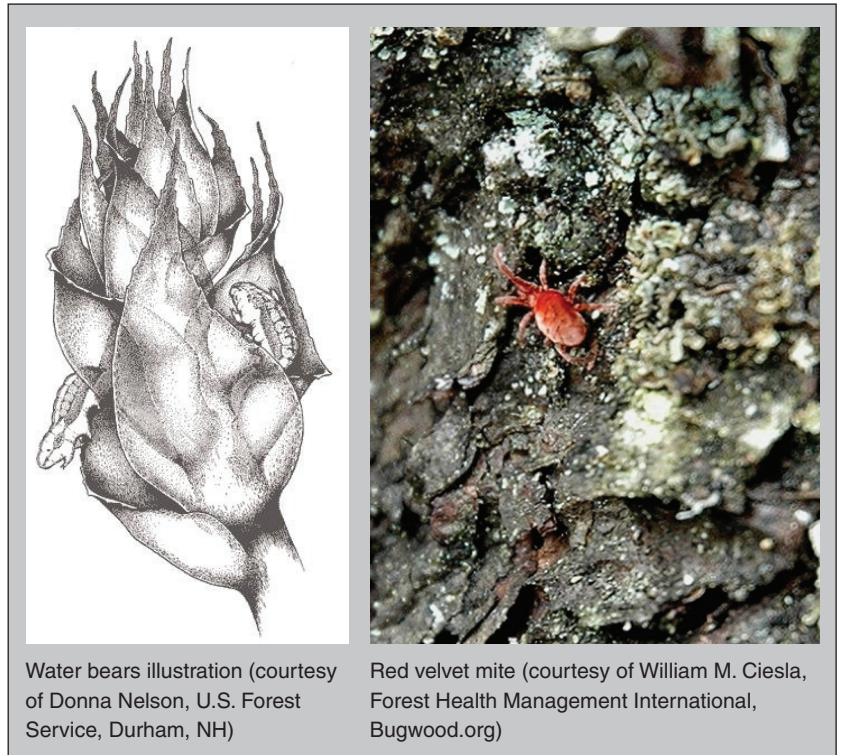


Green mosses are often overlooked as an important component of biodiversity in woodlands of the Northeast. Mosses grow on a variety of substrates such as tree trunks, stumps, downed woody debris, soil, and rocks and boulders on sites that range from periodically dry to wet, even submerged in water. For example, the white-tipped moss (*Hedwigia ciliata*) grows on exposed rocks and boulders subject to drying. At the other end of the moisture spectrum, the brook moss (*Fontinalis antipyretica*) grows on rocks, logs, and branches that are sometimes submerged throughout the year in flowing water or sometimes in lake margins.

Perhaps it was the brook moss that the famous American writer Nathaniel Hawthorne noted in 1854 when he was at the site of the Old North Bridge, fought over in the American Revolution: “Looking down into the river, I once discovered some heavy fragments of the timbers, all green with half-a-century’s growth of water-moss; for, during that length of time, the tramp of horses and human footsteps have ceased, along this ancient highway.”

All mosses are important in absorbing and slowly releasing moisture from rainfall. This helps reduce soil erosion from rainfall and provides moisture on drier days, both important ecological functions in forested environments. By intercepting rainfall, mosses help prevent leaching of nutrients from the forest soil.

Mammals, such as shrews and mice, use mosses for habitat and shelter. Spiders, insects, and the microscopic organisms they eat use mosses as well. According to one source, one gram of moss (i.e., the size of a muffin) typically produces 150,000 protozoa; 132,000 tardigrades (water bears); 3,000 springtails; 800 rotifers; 500 nematodes; 400 mites; and 200 fly larvae (Source: *Gathering Moss – A Natural and Cultural History of Mosses* by Robin Wall Kimmerer, Oregon State University Press, Corvallis). Invertebrates are attracted to mosses because of the favorable microclimate,



Water bears illustration (courtesy of Donna Nelson, U.S. Forest Service, Durham, NH)

Red velvet mite (courtesy of William M. Ciesla, Forest Health Management International, Bugwood.org)

shelter, food, nutrients, and the complex internal structure that creates high habitat diversity.

The four-toed salamander (*Hemidactylium scutatum*) likes to breed in mossy areas in wetland depressions, along streams, and in bogs. It lays its eggs deep between moss plants, often in sphagnum moss hummocks. Some bird species also use mosses to line their nests (see *Bryophytes Used in Construction of Bird Nests*. Spring 1976. *Bryologist*. Vol. 79(1)).

Not many organisms eat mosses. Slugs, for example, mostly eat the capsules, according to Dr. Bruce Allen of the Missouri Botanical Garden (personal communication). Dr. Allen says that in his field work he has seen “abundant evidence of ants either cutting off capsules and carrying them away or removing spores from capsules.” Dr. Kate Frego of the University of New Brunswick has seen red-backed and heather voles selectively eating some moss species, and spruce grouse eat the capsules of *Polytrichum* mosses, presumably for their high protein and fat content (personal communication).

To us, mosses reflect the feelings of serenity and peace, and are used as signature species in Japanese gardens for this purpose. Mosses are also used in the florist trade and for home decorations in flower arrangements and other purposes of adornment. *Sphagnum* mosses are dried and used as a plant growing medium and as horticultural soil additives, fuel, and historically as bandages to soak up blood. Mosses are indicative of great age and successful dispersion, appearing in fossils 400 million years old and totaling about 15,000 species from the Arctic to the Antarctic (*Moss Gardening* by Bruce Schenk).

This article provides some basic information on morphological characteristics of mosses that are useful in identification and presents some descriptions and photographs of mosses that perhaps grace your woodlots here in the Northeast. Unfortunately, mosses are challenging to learn because identification frequently requires expensive, high-magnification microscopes. Even with these, the morphological characteristics that are used to separate some species are often weak (see Bruce Allen and others 2005).

However, using an inexpensive hand lens (10x or greater magnification), combined with some basic knowledge and experience, can greatly help you identify some of the common, more easily identified mosses. Some of these common species were the subject of an article (see Monthey, R.W.; Mollicone, M.; Dudzik, K.R. March 2002. *Moss and liverwort primer*. Northern Woodlands Magazine). There are also a number of field guides and moss taxonomy books that can assist you; some of these are listed below. In addition, you may live close to a university that teaches courses on mosses, or to a local naturalist society with experience in identifying common mosses.

For those of you wishing to learn just a few of the mosses and how they live, this can be a very fun and rewarding endeavor. A little bit of knowledge will add greatly to the enjoyment of your woodlands. Nathaniel Hawthorne (in *Mosses from an Old Manse*, Vol. 1, 1854) wrote that “Each tree and rock, and every blade of grass, is distinctly imaged, and, however unsightly in reality, assumes ideal beauty in the reflection.”

Since mosses often cover parts of trees and rocks, they too assume this ideal beauty. Many are surprised to discover the beauty of the intricate architecture and color palettes of the mosses themselves when seen at close range. In studying these species, perhaps we will

better understand our own role in nature and find our own reflection of beauty.

Morphological Characteristics of Mosses Useful in Identification

Figure 1 has morphological characteristics of a stylized moss as well as definitions of those characteristics. The gametophyte stage consists of leaves and stems that are very important in identifying mosses. Some of the many leaf characteristics that can help you identify mosses include:

1. Are the leaves rippled (undulate) or not?
Is the costa present or not?
2. Does the costa end before the tip of the leaf, or does it extend beyond the tip as a spine?
3. Are there one or two costae?
4. Is the margin of the leaf serrated (notched like a saw) or not?
5. Are the leaves curled or straight when moist, or are they curled or straight when dried?

Two examples of important stem characteristics include:

1. Do the stems have tomentum (hair-like filaments)?
If so, what color are they?
2. Do the stems have paraphyllia (small appendages that are sometimes green and branched)?

The sporophyte stage (the seta and capsule) is very important in identification as well. A few examples of characteristics associated with the sporophyte that are useful in identification include:

1. Is the calyptra angled or cylindrical in cross section?
2. Is the calyptra hairy or not?
3. Is the calyptra pleated or not?
4. Is the capsule erect or curved?
5. What is the color of the capsule?
6. Are there one or two rings of peristome teeth?
7. What is the color of the seta?
8. Is the seta twisted or not after drying?

The following species descriptions refer to some of these characteristics and others that are important in identifying a specific moss. Look closely at the photos as well to see some of these morphological characteristics.

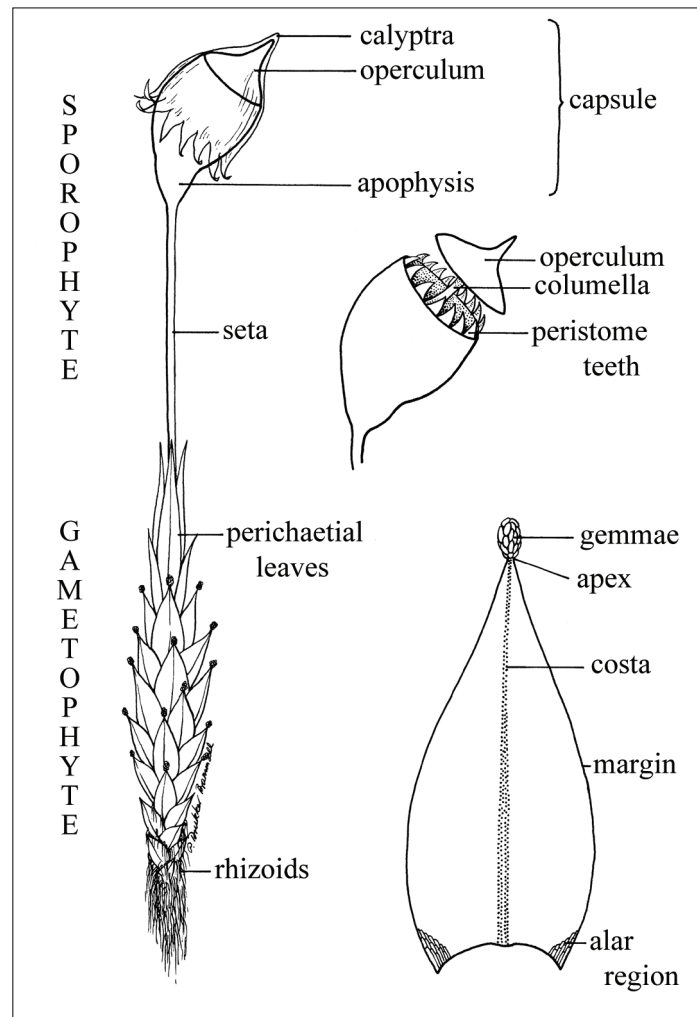


Figure 1. Basic morphology of mosses – stylized and thus is not meant to reflect any specific moss species (printed with permission of W.B. Schofield; drawing by Patricia Drucker Bramall).

SPOROPHYTE – spore-producing phase of the life of a moss

Apophysis – an enlargement at the base of a capsule

Calyptra – sheath that initially surrounds the growing sporophyte and thus is gametophytic tissue associated with the sporophyte; this sheath is torn off by growth of the seta leaving a protective cap at apex of the sporophyte

Capsule – a sac in which spores are produced

Columella – a column-like axis in the capsule of mosses

Operculum – lid of the capsule

Peristome teeth – teeth-like, triangular structures that surround the mouth of the capsule; they are revealed when the calyptra and operculum are shed

Seta – stalk of the capsule

GAMETOPHYTE – leafy phase consisting of stems and leaves

Alar region – wing-like region of leaf

Apex – tip of leaf

Costa – midrib of leaf

Gemmae – cluster of cells that separates from the parent moss to produce a new moss (not found in all mosses)

Margin – edge of leaf

Perichaetial leaves – specialized leaves formed on the female sexual branch that surround several archegonia (or female sex organs)

Rhizoids – root-like filaments that attach moss to substrate

Species Descriptions

These species descriptions follow Glime (1993) and Allen and others (2005).

Feather Flat Moss (*Neckera pennata*)

Description—The leaves are rippled like a “lake on a breezy day” (Glime 1993) or, in technical terms, the leaves are strongly, transversely undulate. The branches are flat in appearance with elliptical, short-pointed leaves twisted to extend on only two sides of the stem.

Habitat—This moss grows on the trunks and branches of trees, and on rocks. The leaves stand out from surfaces in shelf-like appearance. It is indicative of old growth forests in the Northeast.

Curled Leaf Moss (*Ulota crispa*)

Description—This moss grows in dark green clumps. The leaves are straight when wet but curled and twisted when dry. The spore capsule is straight and pleated when empty.

Habitat—Tree trunks above the base of trees. It can grow higher on tree trunks because of its adaptation to increased light and drier conditions. Another moss with curled leaves, the Mountain Fork Moss (described in this article), grows on tree bases.

Four Tooth Moss (*Tetraphis pellucida*)

Description—This moss forms short, dark to pale green tufts of erect, unbranched plants. It has four peristome teeth, a characteristic that is found in only one other moss species (the rarer *Tetraphis geniculata*) in the Northeast. Seasonally, the moss bears gemmae (asexual reproductive structures) that grow in a leafy “cup” on top of the stems. The cups resemble a miniature bird’s nest with eggs.

Habitat—Usually on well-decomposed wood such as logs and stumps, but also on sandstone and soils high in organic matter.

Juniper Hairy Cap Moss (*Polytrichum juniperinum*)

Description—This moss is bluish-green, the color of juniper. It forms short to tall tufts 10–100 mm tall. The leaves are strongly divergent when dry and have reddish hair points (fine tapering of the leaf tips into hair-like projections).

Habitat—It is found on open, dry, sterile soil and within forests; also on road banks and cliff ledges.

Alpine Haircap Moss (*Polytrichastrum alpinum*; synonym *Pogonatum alpinum*)

Description—The gametophyte structure and appearance are similar to the Juniper Hairy Cap Moss and other *Polytrichum* species. The calyptra is hairy like *Polytrichum* species but the capsules are round in cross section compared to the angled capsules in *Polytrichum*.

Habitat—Dry boulders in open woods.

Mountain Fork Moss (*Orthodicranum montanum*; synonym *Dicranum montanum*)

Description—The leaves are strongly curled (look like corkscrews) and can break off to form new plants. The capsules are straight.

Habitat—Tree bases (lower parts of trees), logs, and forest boulders.

Broken Fork Moss (*Orthodicranum viride*; synonym *Dicranum viride*)

Description—This moss is dull, dark green to bright green. The leaves are crowded and erect-spreading to erect-incurved with fragile points that are often broken (see photo).

Habitat—Tree trunks on the bark of maples, birches, ash, oaks, and white cedar; rarely on boulders and rocks in woods.

Forked Moss (*Dicranum ontariense*)

Description—These plants are medium-sized to robust and green or yellowish-green, with dense white or brownish tomentum. This moss has 1-3 setae and is yellow in color. The leaves are spreading, undulate, flexuous, lanceolate in shape, and strongly keeled; the upper leaf margins are sharply serrated. The name Forked Moss comes from the fact that *Dicranum*’s peristome teeth are forked.

Habitat—This moss grows on the forest floor and on humus or soil over rocks, boulders, and cliffs. It is found in shaded and forested or sunny and exposed situations.

White-tipped Moss (*Hedwigia ciliata*)

Description—According to Howard Crum, this species was named for Johannes Hedwig who wrote *Species Muscorum Frondosorum* in 1801, which is accepted as the starting point for moss nomenclature. He was a Professor of Botany at the University of Leipzig in Germany. This moss is a robust, rigid plant growing in mats, with crowded leaves that are erect, ascending, or

creeping. Leaves are crowded in rows, appressed when dry, spreading when moist, and have acute or acuminate leaves ending in whitish hyaline tips.

Habitat—On dry, granitic boulders in open woods and in scrubby pastures or along roadsides.

Carpet Moss (*Mnium hornum*)

Description—These plants are medium-sized to robust in tufts or dense cushions. The stems are dark reddish-brown and densely hairy below, and yellowish-green above. Leaves are erect to spreading when wet, and spirally twisted to somewhat contorted when dry; leaf margins are doubly serrate, and the costae are stout, toothed on the back, and end below the acute leaf apex. The setae are yellow when young, becoming orange to red. According to Allen and others (2005), this is the common species of *Mnium* in Maine.

Habitat—Grows along streambanks and on wet soil in the forest (Allen and others 2005). Also grows on dry or seeping cliffs and rock ledges, tree roots, and occasionally on rotting logs.



Some Useful References

A few references that can help you identify mosses and appreciate these remarkable plants include:

1. Allen, Bruce [author]; Anderson, Lewis E. [contributor]; Pursell, Ronald A. [contributor]; Redfearn, Paul L., Jr. [contributor]. 2005. Maine Mosses: Sphagnaceae-Timmiaceae. *Memoirs of the New York Botanical Garden*. 419 p.
2. Crum, Howard. 1983. *Mosses of the Great Lakes Forest*. 3rd ed. University of Michigan, Ann Arbor, MI. [Originally published as *Contributions from the University of Michigan Herbarium*.] 417 p.
3. Glime, Janice. 1993. *The elfin world of mosses and liverworts of Michigan's Upper Peninsula and Isle Royale*. Isle Royale, MI: Isle Royale Natural History Association. 148 p.
4. Schofield, W.B. 1992. *Some common mosses of British Columbia*. Victoria, British Columbia: Royal British Columbia Museum. 394 p.

We would like to thank Dr. Bruce Allen of the Missouri Botanical Garden and Dr. Kathleen Frego of the University of New Brunswick for reviewing this article and providing excellent suggestions.

View of the Feather Flat Moss (*Neckera pennata*) showing its epiphytic shelf-like growth pattern on trunks and branches in our Northeastern forests. (Photo by Kenneth R. Dudzik)



Left: View of Curled Leaf Moss (*Ulota crispa*) growing on a tree trunk. (Photo by Roger Monthey)
Right: A closer view of the setae and capsules. (Photo by Kenneth R. Dudzik)



Left: View of the growth pattern (center top of stump) of Four Tooth Moss (*Tetraphis pellucida*) on old decomposing stumps, logs, and branches. (Photo by Roger Monthey)



Right: A closeup view of the numerous setae and the capsules on top of them. (Photo by Kenneth R. Dudzik)



Left: View of Juniper Hairy Cap Moss (*Polytrichum juniperum*) showing its turf-like growth pattern.



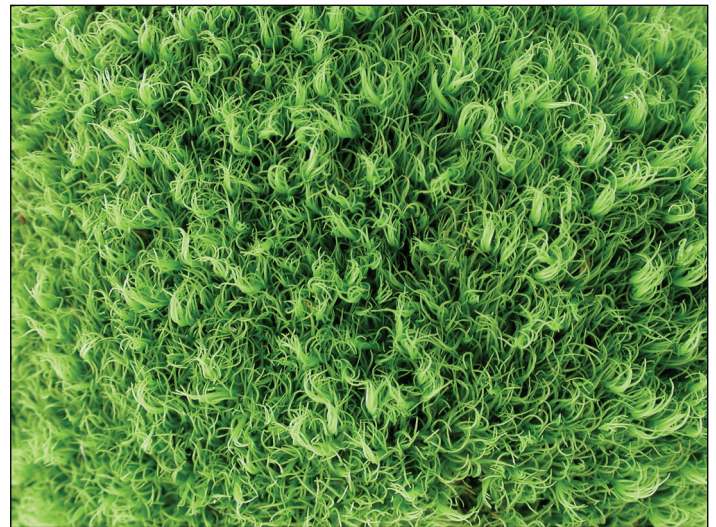
Right: A closeup of the angled capsules and the hairy calyptrae that cover them. (Photos by Kenneth R. Dudzik)



Alpine Hairy Cap Moss (*Polytrichastrum alpinum*) growing on top of a granite boulder in open oak-pine woods. (Photo by Kenneth R. Dudzik)



Left: View of Mountain Fork Moss (*Orthodicranum montanum*).



Right: A closeup view of the curled leaves. This is a common moss of Northeastern forests that grows at the bases of trees and on granitic boulders. (Photos by Kenneth R. Dudzik)



Left: View of Broken Fork Moss (*Orthodicranum viride*).



Right: A closeup view showing the tips of the leaves, which are fragile and often break. (Photos by Kenneth R. Dudzik)



Forked Moss (*Dicranum ontariense*) collected from a layer of humus on a boulder. Note the white and reddish-brown tomentum on the stems. (Photo by Roger Monthey as adjusted by Kenneth R. Dudzik)

The white-tipped moss (*Hedwigia ciliata*) grows on exposed boulders subject to drying in open woods. (Photo by Kenneth R. Dudzik)



The Carpet Moss (*Mnium hornum*) is a common species in New England, especially in coastal regions. Note the male plants with antheridia (male reproductive structures producing gametes that contain only a single set of chromosomes) in terminal discoid cups. (Photo by Kenneth R. Dudzik)

Authors:

Roger Monthey works at the Northeastern Area State and Private Forestry field office in Durham, NH 03824-0640, phone: 603-868-7600
Kenneth R. Dudzik, U.S. Forest Service, Northern Research Station, Durham, NH

The USDA is an equal opportunity provider and employer.